

PRELIMINARY ENGINEERING REPORT

SPOT IMPROVEMENTS FOR ROUTE 140

RECONSTRUCTION OF ROUTE 140
ELLINGTON, CT

PROJECT No. 47-105

PREPARED FOR:

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

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Attachments

- * Preliminary Engineering Report plans "Spot Improvements for Route 140"
- * Not available on-line. Copies are available for review in the Town Clerk's Office, First Selectman's Office and the Department of Public Works.

INTRODUCTION AND PROJECT DESCRIPTION

This project involves the investigation of spot improvements within a segment of Route 140 in Ellington from Route 83 to Route 30. A Preliminary Engineering study was previously prepared for this project in 1997 that led to a Final Plans for Review Submission in 2001 that involved extensive reconstruction. The original project scope included the reconstruction and realignment of 4 ¼ miles of Route 140 in Ellington and Tolland. The project limits were from approximately 1000 feet west of the Route 83 intersection to the Route 30 intersection. Design plans were developed and they included the following: major horizontal and vertical adjustments; major realignment at the Route 83 and Route 140 intersection; realigning five other intersections; widening the pavement to 32 feet; providing clear zones; a stream realignment for Kimball's Brook; culvert replacement at Charter's Brook; new box culverts at Martin's Brook; two wetland mitigation sites and major drainage improvements. Based on the Final Plans for Review submission, property acquisitions were initiated and 43 out of 55 were acquired until the project was suspended.

The order of magnitude of the construction estimate for the originally scoped work exceeded the available funding allocated by the Department, causing the project to be suspended. Additionally, it was determined that the original scope did not adequately address the needs of the Department and community due to cost concerns and property disturbances. On April 6, 2005 the Department met with Town Officials to review specific safety issues within the original project scope limits. This resulted in the following list of areas requiring a Preliminary Engineering study:

- Route 83/ Route 140 Intersection Synchronized Signal
- Route 140 Road Improvements from Pinnacle Road to Teabury Ridge
- Charter's Brook Reconstruction
- Intersection Sight Distance Improvements at the intersections listed below:
 - Pinnacle Road / Hopkins Road
 - Webster Road / Shenipist Lake Road
 - Ludwig Road
 - Newell Hill Road
 - Burbank Road

In addition, the Department decided to add the evaluation of existing drainage issues within the above list of areas to the Preliminary Engineering Report.

The items investigated in this report fall under the Department's classification of spot improvements as described in the Highway Design Manual (HDM), improved areas that will not adversely affect the existing geometry. Within this design phase, based on Section 3-2.02.4 of the HDM, no design exceptions are necessary.

ROUTE 83/ ROUTE 140 INTERSECTION SYNCHRONIZED SIGNAL

The Department has performed a traffic warrant analysis for the necessity of a set of synchronized signals within the intersection, between the north and south junctions of Route 140. In a memorandum dated September 20, 2005 from CDOT Division of Traffic to CDOT Consultant Design the Department recommends signalizing the entire intersection and have provided the following lane arrangements:

North Junction of Rte. 83 and Rte. 140:

- Northbound: A through lane
A right turn lane
- Westbound: A left turn lane
A 150' right turn lane
- Southbound: A 150' left turn lane
A through lane

South Junction of Rte. 83 and Rte. 140

- Northbound: A 150' left turn lane
A combination through and right turn lane
- Westbound: A combination left, through and right turn lane
- Southbound: A left turn lane
A through lane
A right turn lane
- Eastbound: A left turn lane
A 150' combination through and right turn lane

The design of this synchronized signal will be done by the Department.

ROUTE 140 ROAD IMPROVEMENTS FROM PINNACLE ROAD TO TEABURY RIDGE

The Route 140 roadway from Pinnacle Road to Teabury Ridge contains multiple sharp curves including back to back s-curves. Wetland areas and steep slopes adjacent to the existing road complicate any possible realignment options. The Preliminary Design Report done in 1998 by Lochner contained a detailed description of the existing issues regarding this section of roadway.

The 85th percentile speed, as indicated in the Preliminary Design Report done in 1998, was 49.3 mph for Eastbound traffic and 50.2 mph for Westbound traffic. Therefore, the design speed was set at 50 mph. The posted speed is set at 45 mph. For purposes of this study any proposed design values will try to achieve the 50 mph design speed. Proposed design criteria is from the Connecticut Department of Transportation Highway Design Manual, 2003 edition and a Policy on Geometric Design of Highway and Streets, 2001 edition by AASHTO.

This particular area was the subject of multiple alternates investigated during and prior to the Final Plans for Review Submission back in October of 2001. All of the alternates involved either the smoothing out or softening of curves within this area. The alternate used in the final plans included squaring up Pinnacle Road to Route 140 as well as relocating the Hopkins Roads intersection opposite it. In addition, Kimball's Brook was relocated to the north. The existing wetlands located at Station 10+600 +/- was used as a critical control in the development of the proposed alignment final alignment back in 2001. Within the area of the curve located at Station 10+700 +/- the proposed alignment went through the existing rock outcrop. This alternate became cost prohibitive and complicated to construct and is therefore deemed to drastic of a recommendation for this study. Please refer to the Preliminary Design Report dated, November 23, 1998 for a more comprehensive explanation of the preliminary investigation provided for the Final Design Plans.

The intent of this study was to look into minor changes to the roadway to try to improve overall driving conditions. One of the improvements was to look into optimizing superelevation for the design speed and existing geometry. As previously mentioned a design speed of 50 mph was used as a basis for the superelevation development. Based on the initial study, there are areas where the existing cross slope in conjunction with the existing radiuses is not adequate for the design speed. The plans attached to this report show specific areas where the superelevation should be reestablished to maximize the traveling speed. It is recommended to mill and overlay the entire subject area from Pinnacle Road to Teabury Ridge a total distance of 4,790 LF ±. There is also an area indicated on the plans (Sta. 11+800 to 11+920) where the profile should be adjusted. The profile would be raised to smooth over the depression in the road. Instead of raising the profile, more intense milling could be done in this area to lower the surrounding roadway. But this could lead to removing too much of the existing pavement and as a result end up

with an insufficient depth of bituminous. Further study of this area is also needed to properly address any potential drainage issues.

In addition, one of the curves within this area containing substandard geometry could be revised to be included as a spot improvement for this area. It is the curve at Station 10+700 +/-, approximately 230 feet west of house # 169 with a radius of 420 feet +/- . To meet current design standards for a 50 mph design speed with maximum superelevation the radius would be a minimum of 840 feet. The curve swings around a large rock outcrop adjacent to the north side of the road resulting in a severely limited stopping sight distance. A review of the accident history for the area indicates numerous accidents occurring within the area of this curve. The curve is further constrained by a limited amount of tangent available to allow for superelevation transitions prior to and after the curve. These two items; insufficient stopping sight distance and radius could be improved. Ideally, the radius should be increased to the recommended amount for a 50 mph design speed but this is not feasible without impacting the adjacent curves. It could be increased to 510 feet for 40 mph or maybe 665 feet for 45 mph. To accomplish this road could be shifted to the south, away from the rock outcrop. This would have to be balanced with the impact to the wetlands, west of the curve. The soils report dated, October 2000, provided for the original project, indicates a minimum 13-15 foot shoulder with rock cuts at 6V:1H within this area. Shifting the proposed road to the north would impact the rock outcrop and may increase the construction cost substantially due to necessary blasting and benching of the rock slope. Therefore, the rock outcrop could be used as a project constraint thereby forcing the proposed road to the south. The realignment of this curve to the south would have to account for drainage to the north of the road. Existing grades indicate that a swale could be developed to drain the north portion of the road west into the existing culvert.

Construction of this spot improvement by shifting the road to the south could be accomplished under existing traffic. The outside portion, or southern most, of the road would be constructed first while keeping traffic to the north on the existing road. Alternating one-way traffic may be necessary. Then traffic could be shifted onto the new portion while the northern portion is constructed. This spot improvement would improve one of the curves within the area from Pinnacle Road to Teabury Ridge.

It is anticipated that any improvements to the curve at Station 10+700 +/- will involve wetland impacts. This will involve approval from the local wetlands board and additional permits may be necessary depending on the funding sources of this project. Additional property acquisitions may be necessary as well.

Clear zone is an issue within the area of the s-curves which is not easily addressed. The existing topography consists of the roadway bounded by steep slopes, watercourses and wetlands. Any modifications to increase clear zone for a 50 MPH design speed while maintaining the existing alignment would require substantial rock cuts.

Existing radii are labeled on the attached plan set and listed in Table 1 with the appropriate superelevation and stopping sight distance.

Table 1
Proposed Superelevation and Stopping Sight Distance

Radius	Existing Superelevation	Estimated Stopping Sight Distance (SSD)
(Ft)	(e)	(ft)(speed)
1091.5	5.8	305 (40 mph)*
525	6.0	305 (40 mph)
420	6.0	155 (25 mph)**
1017	5.9	360 (45 mph)
1729	4.6	425 (50 mph)

*SSD on the curve by Hopkins Road would be improved if the Intersection Sight Distance was modified as recommended in the report.

** There is a large rock outcrop on the inside of the curve.

Estimated Construction Cost for the mill and overlay and reestablishing the superelevation within the limits shown on the attached plan set is \$280,000.

Estimated Construction Cost for the spot improvement at the curve at station 10+700 would be \$155,000 (not including additional property acquisitions)

CHARTER'S BROOK BRIDGE RECONSTRUCTION

A 90% plan submission for a complete replacement of the bridge over Charter's Brook was submitted on August 1, 2001. These plans detailed the staged removal of the existing single span bridge and its replacement with a twin barrel culvert. The proposed culvert was designed for the proposed realignment and widening of Rte. 140, including a significant change in the profile through this area. This replacement was recommended to address the deteriorated structural condition of the bridge which was rated "poor", and to accommodate the new widened roadway configuration. Lochner has reviewed the recent Bridge Inspection Reports from the Department completed on August 30, 2004 and a special inspection on August 31, 2005. These reports note specific concerns regarding the advanced deterioration of the concrete substructure and the overall rating for the bridge remains "poor". Therefore, the need to address the structural condition of the existing bridge still remains. However, the Department is now considering the structural replacement without significant roadway section and profile modifications in the area of the Charter's Brook.

The replacement concept developed in 2001 remains a valid alternative for this site with a need for some minor adjustments to address the reduced scope of roadway work in the area. The proposed twin precast culverts improve the hydraulic capacity at the crossing and eliminate the maintenance and inspection costs associated with the existing structurally deficient bridge. Construction staging will remain similar with a need for 4 stages (2 traffic stages with 2 water handling stages within each traffic stage) to construct the culverts while maintaining both traffic and stream flow at the site. Alternating one way traffic will be required on Route 140 for a duration of 4 to 6 months to allow for the construction. It is also required to increase the length of the proposed culverts beyond the current length of the bridge to provide the minimum roadway widths required for the alternating one way traffic during staging. This overbuild requirement is the same that was required for the staging detailed in the 2001 submission. The culverts designed and detailed in the 2001 submission accommodated an increase in the profile of Route 140 of approximately 500 mm. This increase in profile is not required for the concept now being considered and the culvert headwalls would be reduced in height accordingly.

The Hydraulics Report for Charter's Brook developed for the culvert replacement concept advanced in 2001 will need to be revised to address the significant change in the profile of the Route 140 embankment but it is expected that the changes will not adversely affect the proposed hydraulics for this site. Since the proposed culvert length and roadway width will be the same as for the previous concept, this will require similar impacts to the wetlands adjacent to the brook as in the 90% plans. In addition, any of the environmental permits originally submitted for the bridge replacement will have to be revised and resubmitted. This will include the Flood Management Certification and Inland Wetland Permit.

The quantity estimate developed in 2001 for the structural items required for the replacement culverts remain the same except for minor changes associated with the reduction in height of the headwalls. The cost estimate for the work now being considered requires the roadway, and traffic staging items associated with this work to be considered as part of this improvement. These costs previously were considered in the overall roadway reconstruction costs. Table 2 identifies the estimated construction costs in 2005 dollars to replace the Charters Brook Bridge with the twin culverts.

Table 2				
Charter's Brook Reconstruction				
Estimated Cost per 9/21/2001 revised Estimate	LS	1	\$301,358.00	\$301,358.00
Construction Cost Index 2001-2005 (ENR) 1.298*	LS	1	\$89,804.68	\$89,804.68
Roadway Items	LS	1	\$69,580.00	\$69,580.00
Clearing & Grubbing (2 %)	LS	1	\$9,214.85	\$9,214.85
Mobilization (7.5%)	LS	1	\$34,555.70	\$34,555.70
MPT (10.0%)	LS	1	\$46,074.27	\$46,074.27
Const Staking (1.0%)	LS	1	\$4,607.43	\$4,607.43
		Total		\$555,200

*Construction Cost Index taken from Engineering News Record for the city of Boston, MA.

INTERSECTION SIGHT DISTANCE IMPROVEMENTS

The following intersections have been analyzed with respect to Intersection Sight Distance (ISD); Pinnacle Road, Hopkins Road, Webster Road, Shenipsit Lake Road, Ludwig Road, Newell Hill Road and Burbank Road. All existing ISD values are summarized below in Table 3.

Table 3 Existing Intersection Sight Distance				
Roadway	Looking Left	Actual Speed Based on ISD	Looking Right	Actual Speed Based on ISD
	(ft)	(mph)	(ft)	(mph)
Pinnacle	290	25	448	40
Hopkins	191	<20	158	<20
Shenipsit Lake	440	40	300	25
Webster	500	45	190	<20
Ludwig	270	<25	410	35
Newell Hill	121	<20	113	<20
Burbank (NorthBound)	244	20	988	50
Burbank (SouthBound)	328	25	167	<20

Only a few components of the intersections analyzed meet the ISD for the posted speed limit. Each intersection was individually analyzed to determine the best solution and is shown in the attached plan set on drawings ISD-01 to ISD-09. Any of the proposed alternatives shown that require excavation work will have to be further evaluated for constructability and drainage. Table 4 at the end of this section summarizes the construction costs.

Pinnacle Road

A 40 mph design speed to the left could be achieved with keeping the intersection in its existing configuration. However, it will require a modification to the easement to slope onto Town property previously acquired in 2001. To achieve an ISD for 50 mph would require the realignment of the terminus of Pinnacle Road as shown in drawing ISD-02. This “button hook” roadway realignment would make use of land previously acquired in 2001. It is important to note that the existing speed of Eastbound traffic on Route 140 prior to the intersection is limited to approximately 35 mph, based on existing horizontal curvature. A section in drawing ISD-04 shows the proposed realignment of Pinnacle Road.

Hopkins Road

A 50 mph ISD to the right will require an easement across the thin slice of property owned by Spugnardo that was not previously acquired in the original engineering proposal when the rest of the surrounding areas were acquired. Acquiring this parcel may not be an issue due to the location and size.

A 50 mph ISD to the left will require select clearing.

Shenipsit Lake Road

A 50mph ISD to the right could be achieved within the existing ROW. Minor grading and clearing will need to be done. Based on the grading the existing span pole may need to be relocated.

The existing ISD to the left is for 40 mph. Any ISD increase would require lowering portions of the existing profile on Route 140. This area is also within a crest vertical curve within a cut section of Route 140. Any option to modify the existing road profile will require further investigation.

Webster Road

A 50 mph ISD to the right would require an easement on the adjoining property. In this area, easements were applied for during the previous design process but never obtained. Therefore, the recommended improvement will be designed to be constructed within the existing ROW. The recommended ISD improvement is 30 mph to the right as shown in Drawing ISD-06 and ISD-07.

A 50 mph ISD to the left is achieved, minor clearing of vegetation should be done to maintain and/or improve this area.

Ludwig Road

A 50mph ISD to the right will require clearing and minor grading over the existing ROW. An easement across this portion of property was acquired in 2000.

A 50 mph ISD to the left will require grading and clearing within the existing ROW, see Drawing ISD-08.

Newell Hill Road

Easements for the surrounding property were applied for during the previous design process but never obtained. This intersection has the most severely limited ISD's and the most restrictive topology. Any adjustments to the ISD would require major cuts to embankments adjacent to Route 140 outside of the existing ROW. Based on the severity of the inadequate ISD and condition of this road different options may need to be explored. One option could be changing the flow of existing traffic on Newell Hill Road

to only allow traffic to enter from Route 140, converting a portion of the road to one way traffic. If this was done a cul-de-sac and appropriate signage would need to be added to the area on Newell where the residential homes begin.

Even to create a 25 mph ISD an easement would be required for either direction. At the very least, vegetative clearing should be done up to the ROW line for both directions.

Burbank Road

Due to the existing crest vertical just west of the intersection looking right on the North side would require profile adjustments to Route 140 to achieve ISD values for 45 and 50 mph. By clearing all vegetation up to the ROW an ISD of 30 mph can be achieved. The area looking left on the north side of Route 140 requires vegetative clearing to achieve a 50 mph ISD.

On the south side of Route 140 looking left a 50mph ISD would require an unrealistic cut (over 8 feet) through the embankment area adjacent to Route 140. It would create a large depression in an area that is currently a fill area. A 30 mph ISD would require clearing all vegetation up to the ROW line from the intersection to a point about 350 feet west. A 35mph ISD would require cutting into the existing bank. The cut would go over the ROW line falling within an easement for grading obtained as a result of the previous design project. Any higher design speed would require adjustments to the Route 140 profile.

Table 4

Estimated Construction Cost for ISD Improvements

Road	Description	Construction Cost
Pinnacle (Option 1)	40 mph left & clearing right	\$33,700
Pinnacle (Option 2)	50 mph left & clearing right	\$84,300
Hopkins	50 mph left & right	\$78,500
Shenipsit Lake	50 mph right & clearing Left	\$17,800
Webster	30 mph right & clearing left	\$8,700
Ludwig	50 mph right & 50 mph left	\$3,900
Newell	Vegetative clearing only	\$3,300
Burbank	35 mph left & all clearing	\$4,000

AREAS WITH EXISTING DRAINAGE ISSUES

The Final Plans for Review dated August 1, 2001 (Final Plans) show almost all the existing drainage replaced due to the extent of the proposed reconstruction. Most of the cross culverts were scheduled to be replaced in kind. A large percentage of the existing roadway areas do not have curbing, thus, allowing the water to be conveyed into swales and then into a system of cross culverts. This type of open system has the benefit of allowing water to be filtered through the natural vegetation on the sides of the road.

A Final Drainage Report was submitted along with the Final Plans. The report was reviewed with respect to the areas studied within the limits of the Preliminary Engineering Study but also includes areas of concern outside the limits. The scope of work associated with this project is to evaluate existing drainage issues described in the Final Drainage Report. In general, any evaluation, including field inspections and structural evaluations, of existing culverts or drainage structures would be required in the next phase of design, a Preliminary Design.

The following areas were described in various final design documentation submitted as part of Reconstruction of Route 140 in August of 2001:

- The 48" RCP at Sta. 10+215 (RT of Sta. 3+290 Final Plans reference). Hopkins Road, Pinnacle Road and Route 140 are shown as a realigned intersection in the Final Plans, requiring a new culvert along with the relocation of Kimballs Brook. The current proposed project involves only reestablishing the superelevation in this area. It is noted in the report entitled "Kimballs Brook Relocation", the following is stated; "The existing culvert is hydraulically adequate and appears to be structurally adequate..." If an additional project is initiated involving the structural evaluation of this culvert and if this culvert is determined to be inadequate then a replacement will need to be designed to account for fish passage. The "Kimballs Brook Relocation" report identifies a number of items necessary for fish passage including; setting the pipe below grade to allow sediment to accumulate and using a bigger diameter pipe than hydraulically necessary to manually place sediment in the pipe. This will impact the adjacent wetlands, requiring an Inland Wetlands Permit from DEP. Also, maintenance and protection of traffic and water handling measures will need to be designed.
- The 24" RCP at Sta. 10+540 (Sta. 3+607 Final Plans reference) was described as being adequate in the Final Drainage Report, however, the endwalls were noted as being in poor condition. A field investigation may be necessary to determine the current condition of the endwalls. If replacement is necessary, an Inlands Wetlands Permit from DEP may be needed.
- 48" Diameter RCP at Sta. 11+425 ± (Sta. 4+485 Final Plans reference)
This culvert was found to be filled with approximately one foot of sediment. The pipe was analyzed for this existing condition and found to be inadequate for a 50-year frequency storm. The original design proposed the use of twin pipes with

one set lower to facilitate fish passage. This culvert is recommended for replacement. The Final Plans showed the profile increased by two feet in this area. Therefore, hydraulic computations will need to be redone and the pipes checked for adequate cover. In addition, the permit will need to be revised.

The following culverts are outside of the current project limits but are included because they are areas of concern:

- 15" Diameter RCP at Sta. 5+540 (Final Plan reference). There is no station corresponding to the current project as this is outside of the project limits. This culvert drains from the north, under Rte. 140 and outlets 60 feet north of an existing driveway, then into a ditch and through a culvert under the driveway. The Final Plans depicted this pipe replaced and extended to outlet south of the existing driveway, eliminating the open ditch between Rte. 140 and the driveway.
- 24" Diameter RCP at Sta. 5+650 (Final Plan reference). This culvert was eliminated in the final design at the request of the property owner west of the outlet; House No. 102. The drainage from the 24" RCP was shown as being handled by a system of catch basins on the north side of Rte. 140, draining to the west, and eventually outletting into the culvert at Sta. 5+540.
- 15" Diameter RCP at Sta. 6+498 (Final Plan reference). This culvert was determined to be hydraulically inadequate and shown to be replaced with twin 36" diameter pipes. The Final Plan design increased the profile by 5 feet. Any new design parameters such as, leaving the existing road profile as is, will require the hydraulic computations and permits to be redone.
- 15" Diameter RCP at Sta. 6+740 (Final Plan reference). This culvert was determined to be hydraulically inadequate and shown to be replaced with twin 30" diameter CM pipes. The Final Plan design increased the profile by 3.5 feet. If revised conditions are similar to the culvert at Sta. 6+498 then hydraulic computations and permits will need to be redone for this culvert as well.
- Martins Brook at Sta. 7+630 (Final Plan reference), twin 42" diameter RCP's. The hydraulic report classifies the existing pipes as "...incapable of handling even a modest-sized event, of 25-years magnitude, without overtopping." The proposed design includes 3 box culverts, which would convey a 25-year discharge without overtopping the roadway. But, it is further stated in the report "...with the existing Route 140 profile and the existing Burbank Road crossing, Route 140 will overtop at discharges equal to or greater than a 50-year frequency, *regardless* of the size or number of culverts at that location." Therefore, the culvert at Burbank Road must be increased to allow at least a 50-year storm event to pass at Route 140. The profile shown in the Final Plans increases the profile by 3.5 feet. By not increasing the profile hydraulic calculations and the permits will need to be revised.

In addition to replacing the culvert at Sta. 11+425, any plugged culvert pipes and catch basins should be cleaned.

Total estimated construction cost to replace the culvert is \$26,000

SUMMARY

The following recommendations are proposed based on the investigations conducted for this Preliminary Engineering Report.

Based on the results of the warrant analysis done by the Department the synchronized signal proposed should be designed and constructed for the Route 83 and Route 140 intersection.

The milling and overlay and profile adjustment should be finalized and constructed on Route 140 from Pinnacle Road to Teabury Ridge. There may be additional items, such as drainage, to investigate as the design is progressed to a more complete level.

The existing structurally deficient bridge carrying Route 140 over the Charter's Brook should be replaced with twin precast box culverts.

The intersection sight distance improvements, incorporating Option 1 for Pinnacle Road, as described in the preceding section should be designed and constructed. In addition, the possibility of closing or turning Newell Hill Road into a one-way road should be further investigated. The present condition of traffic entering Route 140 from Newell Hill Road is unsafe.

Existing Drainage structures should be cleaned and the culvert indicated above should be replaced.

Table 5	
Summary of Estimated Construction Costs for all the Tasks associated with the Preliminary Engineering Report	
Task	Construction Cost
Rte. 140 Road Improvements From Pinnacle Road to Teabury Ridge	\$280,000
Charter's Brook Reconstruction	\$555,200
Intersection Sight Distance Improvements (w/ Option 1)	\$149,900
Existing Drainage	\$26,000

Total* \$1,011,100

* Not including the cost of the Preliminary Engineering Report.